



PATENT
Attorney Docket No. 7363.0010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reissue Application of:)
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U.S. Patent No.: 5,792,261)
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Inventor: Kiichi HAMA et al.)
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Issued: August 11, 1998)
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Serial No.: 09/478,370)
)
Filed: January 6, 2000)
)
For: PLASMA PROCESS)
APPARATUS)

Group Art Unit: 1763

Examiner: Alejandro Mulero, L.

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

DECLARATION UNDER 37 C.F.R. § 1.131

1. I, Kiichi Hama, reside at 4201 Miyagawa, Chino City, Nagano Prefecture, Japan.
2. I have a degree in electrical engineering from Yamanashi University. I am employed by Tokyo Electron, Ltd. as an engineer and have been employed in that capacity for twelve years.
3. I am a co-inventor of U.S. Patent Application Serial No. 09/478,370, an application for reissue of U.S. Patent 5,792,261.
4. I have read and understood the above-stated patent application and patent. I also have read and understood U.S. Patent 5,280,154 to Cuomo et al.

5. The invention disclosed and claimed in the above-stated patent application and patent relates to a plasma processing apparatus for processing a process region of a substrate, using a plasma. The apparatus includes a container substantially formed of a conductive material; a partition plate supported by the container and defining an air-tight process container portion and an air-tight auxiliary container portion, and having a window plate made of dielectric; a main exhaust pump for exhausting and setting the process container portion to a vacuum; a work table arranged in the process container portion and having a support face facing the window plate, the substrate being mountable on said support face with the process region facing said window plate; a main supply for supplying a process gas between the window plate and the substrate mounted on said support face, at least part of the process gas being transformable into the plasma; a planar spiral coil for generating an electromagnetic field between the window plate and the substrate to induce generation of the plasma, arranged in the auxiliary container portion and facing the window plate; a power supply section for applying a high frequency voltage to the planar spiral coil; an auxiliary exhaust pump for exhausting and setting the auxiliary container portion to a vacuum; and a pressure controller connected to the auxiliary exhaust pump for keeping a pressure difference between pressures in the process and auxiliary container portions at a minimum value.

6. In the above combination of components, the planar spiral coil plays an important role. The planar spiral configuration of the coil differs significantly from the configuration of the coil used in the apparatus disclosed in the Cuomo

patent. Cuomo uses a three-dimensional spiral coil. In the three-dimensional coil used in Cuomo, electrons travel along a straight line because the inductive field is linear, so plasma density does not increase with wall collision. Density at the periphery is less than at the center, resulting in poor uniformity. In addition, only the lower portion of the Cuomo coil generates electric field to the chamber through the dielectric so efficiency is low. Finally, because the Cuomo coil is three-dimensional, substantial spatial capacity is required for the coil.

7. At the time of our invention, it was customary in the industry to use a three-dimensional spiral coil in this application, similar to Cuomo. When we provided a planar spiral coil with the combination of features related above, we obtained a number of surprising results. These results included (1) an improved etching uniformity; (2) a high etching rate; (3) a lower impedance, resulting apparently from the absence of conflicting magnetic fields; and (4) an absence of reversed current flow. All of these surprising advantages resulted in an improved plasma field over that of a process apparatus having a three-dimensional coil such as that disclosed in Cuomo.
8. These surprising results are not set forth expressly in application Serial No. 09/478,370 (U.S. Patent 5,792,261). Nevertheless, I believe that persons of ordinary skill in the art, with the benefit of our written specification and drawings, after reading our complete application and the description of the invention set forth therein, inherently would recognize that these advantages would result. I believe, therefore, that these advantages are inherent in the description set forth.

9. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that the statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

Respectfully submitted,

By: Kiichi Hama
Kiichi Hama

Dated: August 23, 2001.